Simulating the Dynamics of Simple Societies

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Few topics are more important to the collective good than the identification of a viable system of behavioral norms. All societies have such norms, from the simplest egalitarian cultures to the most complex nation states. Are some normative systems better than others? Is there a reason why human societies are structured in the way that they are? Over the last few years I have been constructing increasingly sophisticated computer models of normative behavior in simple societies. I have concentrated on egalitarian societies (those that lack a rigid leadership hierarchy and which decide things through group consensus) since they appear within the range of first-principles models.

I use discrete agent simulation to model a group of about 100 agents over a period of 10 agent lifetimes [1]. The agents are placed into a fixed environment containing sources of food and materials. Agents have a survival imperative, so that they must find food in order to survive. Agents of opposite sex can mate and produce offspring to sustain the population. The simulations are rule-based, which is to say that agents have rules of behavior that they always follow in a given situation. To assess the effect of different normative systems on social performance, this rule set can be systematically varied and the results noted.

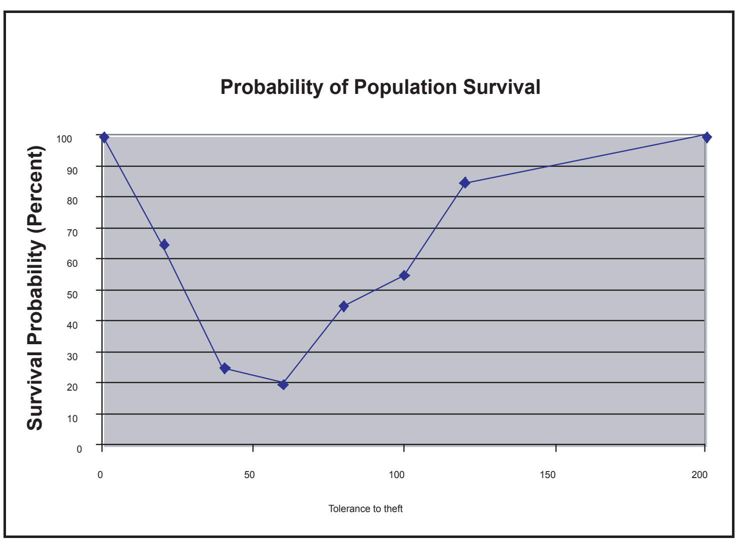

Figure 1—
Probability of survival of the total population vs tolerance to theft.

Agents are divided into two categories: those who share food and materials, and those who steal. Sharing contributes to the personal reputation of the agent and stealing detracts from it [2]. The sum of all agent reputations represents a degree of mutual obligation within the society that is related to social cohesion. Since mate selection depends on reputation (not uncommon in simple societies) sharing agents have a long-term advantage which might or might not outweigh the short-term advantage of theft. However, even traditional societies are more complex than black and white reputation. For this reason, I introduce an adjustable "tolerance to theft" that enables an agent who has stolen below that amount to find a mate and pass along its behavioral gene. What is striking from the simulations is that not all values of tolerance result in a sustainable population.

As shown in Fig. 1, low values of tolerance, i.e., strict individual enforcement of norms, results in a high probability of survival of the total population. Likewise, very high values of tolerance, i.e., an "anything goes" mentality, also produce a stable society. It is for intermediate values of tolerance that the society can go unstable and collapse. Population extinction occurs in two steps: first the sharing population is driven out by being unable to accumulate enough food in the face of persistent thefts and their own intrinsic generosity. Next, agents in the stealing population find themselves unable to find suitable mates, resulting in their eventual collapse.

Social cohesion plummets for even moderate values of tolerance. This can be moderated by imposing group sanctions such as ostracism. However, ostracism also reduces the mating pool and this can lead to population instability and collapse. This may be one reason why all known egalitarian societies, from the Eskimos to the Australian Aborigines, practice virtually the same ethics—strong individual enforcement of norms. Group sanctions can improve social

Bliege Bird and Bird [3]			Simulation	
Model	**Prediction**	**Result**	**Rule**	**Result**
Kinship	Households with no partilinear kin nearby should send shares to kin living farther away rather than share with nonkin neighbors	Not supported	Share only within family	Mutual obligation lower than for indiscriminant sharing
Tolerated theft	Larger households should receive larger portions of turtle meat from the distributing household at each butchery event	Supported	Share with head of household only independent of size of family	Mutual obligation lower than for sharing with each individual
Risk-reduction reciprocity	Households that never hunt should never receive shares	Not supported	Do not share with nonsharing agents	Mutual obligation lower than for indiscriminant sharing

Table 1— Simulation models of sharing compared to observations of Bliege Bird and Bird on the Murray Islanders [3].

cohesion for moderate levels of tolerance but at greater risk of population collapse than for the case of strong individual sanctions.

To more explicitly tie the simulations to reality, I constructed simulation models of various forms of sharing (e.g., share only within the family, share only with other agents who share, etc.) and compared them to observations of Bliege Bird and Bird on the Murray Islanders [3]. I found that social cohesion was maximized in the simulation for the same sharing model—indiscriminant sharing—as was found in the real population. Why do people share in resource-rich environments where an individual could quite easily collect enough food and other materials on his or her own? The simulations suggest that indiscriminant sharing enhances a network of mutual obligation between group members that is an integral part of social cohesion [4].

The next step in the project is to simulate the onset of group violence. Why do groups of people go to war with one another? Again focusing on simple societies, the working hypothesis is that very small groups cannot afford to fractionate and fight because it would not enable a sufficient gene pool to evolve. Once the group size exceeds about 1000, however, parallel groups can form and, given the probability of leadership hierarchies in such situations, violence is likely. There is tantalizing evidence in Polynesian history to support this hypothesis, and I am working with anthropologists to develop a meaningful database of comparisons for the simulations. Once the model has been developed it would be interesting to study the interaction of groups with different normative systems, such as we now face with military interactions with tribes in Iraq and Afghanistan.

[1] Stephen M. Younger, "Discrete Agent Simulation of the Effect of Simple Social Structures on the Benefits of Resource Sharing," *Journal of Artificial Societies and Social Simulation* **6**(3) (2003).
[2] Stephen M. Younger, "Reciprocity, Normative Reputation, and the Development of Mutual Obligation in Gift-Giving Societies," *Journal of Artificial Societies and Social Simulation* **7**(1) (2004).
[3] Rebecca Bliege Bird and R.W. Bird "Delayed Reciprocity and Tolerated Theft: The Behavioral Ecology of Food Sharing Strategies," *Current Anthropology* **38**, 49–78 (1997).
[4] Stephen M. Younger, "Reciprocity, Sanctions, and the Development of Mutual Obligation in Egalitarian Societies," Los Alamos National Laboratory report LA-UR-04-7118 (2004).